

5. The Virginia Nutrient Enriched Waters Designation

by Jean Gregory, Virginia Department of Environmental Quality

The quality of Virginia's surface waters, particularly those in the Chesapeake Bay drainage area, is affected by the presence of nutrient enrichment. In recognition of this, the State Water Control Board (SWCB), now the Department of Environmental Quality, has developed a strategy to protect the surface waters of the Commonwealth of Virginia from the effects of nutrient enrichment.

In the mid-1980's, the State's General Assembly formed a joint legislative subcommittee to study these problems in the Chesapeake Bay. One of the recommendations in their final report was to direct the SWCB to develop water quality standards by July 1, 1988, to protect Chesapeake Bay and its tributaries from nutrient enrichment. The SWCB decided to expand this standards-setting activity statewide to include other river basins and lakes where there were known nutrient enrichment problems. A second legislative mandate to develop implementation strategies for carrying out these water quality standards was made jointly to the SWCB, which has jurisdiction for point sources, and the Division of Soil and Water, which is responsible for nonpoint source controls. As a result, SWCB developed two regulations that became effective on May 25, 1988. The first established a water quality standard that designated as "nutrient enriched waters" those waters of the Commonwealth that show evidence of degradation due to the presence of excessive nutrients. A companion policy regulation was created to control certain point source nutrient discharges affecting State waters designated as "nutrient enriched waters."

To assist them in developing the water quality standard, the SWCB formed a Technical Advisory Committee (TAC) composed of 19 scientists from east coast universities and the Federal government. There were specific issues the Board was seeking advice on prior to developing these standards, including such issues as whether narrative or numerical standards were needed, appropriate parameters and numerical levels, and the appropriate monitoring, sampling, and evaluation methods.

The SWCB used a variety of policy analysis techniques to obtain recommendations from the committee for the best indicators of nutrient enrichment. First, SWCB mailed a series of three delphi questionnaires to the 19 TAC scientists asking them to identify major issues and thereby reach some consensus on topics to focus on. Responses were anonymous so that the scientists would not bias each other. SWCB followed this process with a two-day spring (May 14-15, 1987) workshop held in Williamsburg by the University of Virginia's Institute of Environmental Negotiation. A summary report was compiled.

The Technical Advisory Committee recommended four parameters that could be used as in-stream indicators of nutrient enrichment. Listed in descending order of importance they are chlorophyll *a*, dissolved oxygen (D.O.) fluctuations, total

phosphorus, and total nitrogen. Note that the first two parameters are symptoms of nutrient enrichment rather than direct measurements of nutrients.

Each of these four parameters was considered to develop a recommendation for fresh water lakes.

Chlorophyll a

- Most TAC members favored use of a chlorophyll *a* criterion for lakes. A numerical level of 25 : g/l as a monthly average with a maximum one-time exceedence level of 50 : g/l was proposed. These values received general support from the group. There was a discussion about whether the chlorophyll criterion should be based on planktonic chlorophyll only or whether some consideration should be given to macrophytic chlorophyll as well. It was determined that a planktonic measure would be easier to sample and would accurately reflect the eutrophic condition of the lake.

It was suggested that monitoring samples be taken at one-half the Secchi depth as long as that depth was greater than 1 foot. An alternative proposal was to use an integrated mixed layer sample which, according to some members, would yield more reliable results. The use of Secchi depth is, however, a well-recognized and reliable method and it was favored for its simplicity.

TAC members thought the numerical chlorophyll criterion for lakes should be combined with a narrative element that would deal with the problems caused by high chlorophyll levels—taste, odor, and clogged filters at water treatment plants.

Dissolved Oxygen

- It was the consensus of the TAC group that due to wide variation in D.O. at different depths and the difficulty this creates in setting standards and sampling techniques, and the fact that D.O. problems are symptoms that would be reflected in other standards, no lake criterion for D.O. should be recommended. The group did agree that a narrative component addressing the conditions associated with D.O. problems should be drafted.

Total Phosphorus

- The TAC group suggested two possible lake criteria for total phosphorus in lake waters: a level of 50 : g/l as a weighted mean based on the water mass, or a level of 25 : g/l as a mixed layer mean. These levels were judged to be of equal validity as a measure of total P. (It was noted that if chlorophyll were sampled on a mixed layer basis this might be the preferred approach because the two samples could be taken at the same time.)

Total Nitrogen

-

The TAC group discussed the possibility of linking the criterion for total nitrogen to the criterion for phosphorus. It was suggested that some N to P ratio could be used or that the nitrogen criterion could be set at ten times the phosphorus criterion. After discussion, the group agreed that no nitrogen criterion should be set. Phosphorus is almost always the limiting factor in the eutrophication of Virginia's warm water lakes, and the group thought a nitrogen criterion would be unnecessary.

Recommendations of the TAC

In freshwater lakes the state should consider setting a chlorophyll *a* criterion of 25 : g/l as a monthly average, with a one-time exceedence level of 50 : g/l with both measured at one-half the Secchi depth (if > 1 foot). This should be combined with a total phosphorus criterion of 50 : g/l as a weighted mean or 25 : g/l as a mixed layer mean. A narrative component should be developed as well to address more general chlorophyll *a* and D.O. problems in lakes.

Taking into consideration the recommendation of the committee, the SWCB decided to base its designations for lakes and all other surface waters on the first three parameters. A reference to these parameters was included in the introduction to the water quality standard regulation for designating nutrient enriched waters. SWCB was intentionally silent on the numerical limits because unacceptable amounts of these parameters could vary depending on the type of water body, whether it were a lake, free-flowing river, or tidal estuary. Because every designation would require an amendment to Virginia's water quality standards, and full public participation is required by the agency and State rules for adopting regulations, SWCB felt that the public would be properly notified in every case of the appropriate scientific and numeric basis for these designations.

Average seasonal concentrations of chlorophyll *a* exceeding 25 mg/l, dissolved oxygen fluctuations, and high water column concentrations of total phosphorus have been the indicators used to date to evaluate the historical data and to identify those waters affected by excessive nutrients. Chlorophyll *a*, a pigment found in all plants, was used as the primary indicator because it indicates the quantity of plant growth.

Based on a review of historical water quality records, the SWCB designated as "nutrient enriched waters" three lakes, one tributary to a lake, nine embayments or tributaries to the Potomac River, the Virginia portion of the Chesapeake Bay, and a large portion of the Bay's tributaries. Since this initial round of designations, SWCB has amended the standard to designate the tidal freshwater portion of the Chowan River Basin in Virginia. SWCB intends to continue to review these designations and, during each triennial review of water quality standards, will consider additions and deletions to the list. For example, Lake Chesdin is proposed for designation during the current triennial review of the water quality standards regulation.

As SWCB has authority to issue National Pollution Discharge Elimination System (NPDES) permits, and thereby control point source discharges of nutrients, a policy for controlling certain point sources of nutrients to those waters designated as "nutrient enriched" was established. (Another agency, the Division of Soil and Water, developed strategies for managing nonpoint sources of nutrients to "nutrient enriched waters.") The

policy requires certain municipal and industrial organizations that discharge effluents containing phosphorus to maintain a monthly average total phosphorus concentration of 2 mg/L or less. The 2 mg/L limit was based on the following criteria:

- Limits that are readily achievable by chemical addition processes, as demonstrated by experiences in other parts of the country
- Suggested achievable limits for biological phosphorus removal contained in several reports as well as in State pilot plant studies.

SWCB has found that this level of phosphorus removal would result in meeting the 40 percent reduction goal of total phosphorus for point source discharges from Virginia entering into the Chesapeake Bay.

Municipal and industrial dischargers that release phosphorus in concentrations above 2 mg/l to these “nutrient-enriched waters” are subject to this policy if they have a design flow of 1.0 MGD or greater and a permit issued on or before July 1, 1988. These dischargers were required to meet the 2 mg/l effluent limitation as quickly as possible and, in any event, within three years following modification of the NPDES permit. If the discharger voluntarily accepted a permit that required nitrogen removal to meet a monthly average total nitrogen effluent limitation of 10 mg/l for April through October, the discharger was allowed an additional year to meet the phosphorus effluent limitation.

All new source dischargers with a permit issued after July 1, 1988, and a design flow greater than or equal to 0.05 MGD that propose to discharge to “nutrient-enriched waters” are also required to meet a monthly average total phosphorus effluent limitation of 2 mg/l. All dischargers to “nutrient-enriched waters” that, at the time of that designation, were subject to effluent limitations more stringent than the 2 mg/l monthly average total phosphorus are required to continue to meet the more stringent phosphorus limitation.

The policy regulation also contains language that allows SWCB to require monitoring of discharges when the permittee has the potential for discharging monthly average total phosphorus greater than 2 mg/l and also allows adjoining States to petition the Board to consider rulemakings to control nutrients entering tributaries to their nutrient-enriched waters.

The policy regulation states that after the point source controls are implemented and the effects of this policy and the nonpoint source control programs are evaluated, the SWCB recognizes that it may be necessary to impose further limitations on dischargers for additional nutrient control to prevent undesirable growths of aquatic plants. This policy can thus be viewed as the first phase of a strategy to protect Virginia’s waters from the effects of excessive nutrients.